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Persistence of snake carcasses on roads and its potential effect on estimating roadkills in a megadiverse country

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***Abstract.*—The persistence of fauna carcasses on roads has been considered one of the most relevant factors influencing estimates of road mortality in different taxonomic groups. However, there is a lack of information in this regard in most Neotropical countries. The aim of the present research is to describe and quantify the persistence of snake carcasses on two Colombian roads and its potential relationships with animal body size and the frequency of vehicular traffic. Additionally, to illustrate the importance of correcting roadkill rate estimates for carcass persistence, the roadkill rate of snakes on a secondary road in the study area is recalculated using the results of carcass persistence time, instead of a previously selected arbitrary value (i.e., 7 days). To estimate the carcass persistence time, eighty-one snake carcasses of diverse body sizes (mean length = 46.90 cm ± (SD) 38.46, range = 10.1–224 cm) were placed over sampling points distributed equally on two roads with different traffic frequencies (a primary road with > 2,500 vehicles/day and a secondary road with < 1,000 vehicles/day). Snake carcass degradation was monitored until their disappearance from the road surface. The median persistence time of carcasses on roads was 7.16 h (5.20 h and 14.16 h on the primary and secondary roads, respectively). According to field experiments, around 75% of the carcasses can disappear from the road surface within 30 h after a snake has been killed. The principal cause of the disappearance of carcasses during the day was degradation due to vehicular traffic. As the carcasses tended to increase in size, the difference in their persistence between types of roads increased, with lower persistence on the primary road than on the secondary road. The conclusion from these observations is that excluding carcass persistence time from snake roadkill rate calculations leads to high underestimates of mortality. Therefore, the problem of snakes that are roadkill on the road infrastructure in Colombia is much greater than previously considered.**

Keywords. Andes, Colombia, mortality, Reptilia, road ecology, Serpentes, Squamata, vehicular traffic

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Introduction

Among the ecological effects attributed to the presence of roads is animal mortality due to collision with vehicles (Forman et al. 2003; van der Ree et al. 2015). Fauna roadkill rates have been estimated in thousands to millions of animals per year (Huijser and McGowen 2010; Marsh and Jaeger 2015). For example, in Australia, it has been estimated that up to 12 million vertebrates are killed yearly on roads, while in the United States the estimates are 1 million vertebrates per day (Bennett 1991; Forman and Alexander 1998). However, those roadkill rates can be severely underestimated (Loss et al. 2014; Ruiz-Capillas et al. 2015; Santos et al. 2016) given methodological biases and that many carcasses disappear before being registered by researchers due to factors such as rain, wind, scavenging activity, or vehicular traffic (Bafaluy 2000; Ratton et al. 2014; Slater 2002; Taylor and Goldingay 2004). In fact, roadkill estimates are generally evaluated based upon time ranges of carcass persistence on roads that have been arbitrarily selected or with conservative approximations (Klöcker et al. 2006).

In Latin America, several studies have documented wildlife roadkill rates (e.g., Novelli et al. 1988; Pinowski 2005; Delgado 2007; Coelho et al. 2008; Barri 2010; Rojas-Chacón 2010; Vargas-Salinas et al. 2011; Contreras-Moreno et al. 2013; De La Ossa-Nadjar and De La Ossa 2013; Seijas et al. 2013). Nevertheless, few studies have tested the factors affecting carcass persistence on the roads and hence, have not quantified the discrepancy between the number of carcasses counted by researches and the real number of animals killed on the roads (Santos et al. 2011; Santos et al. 2016; Teixeira et al. 2013). This is concerning because the accurate

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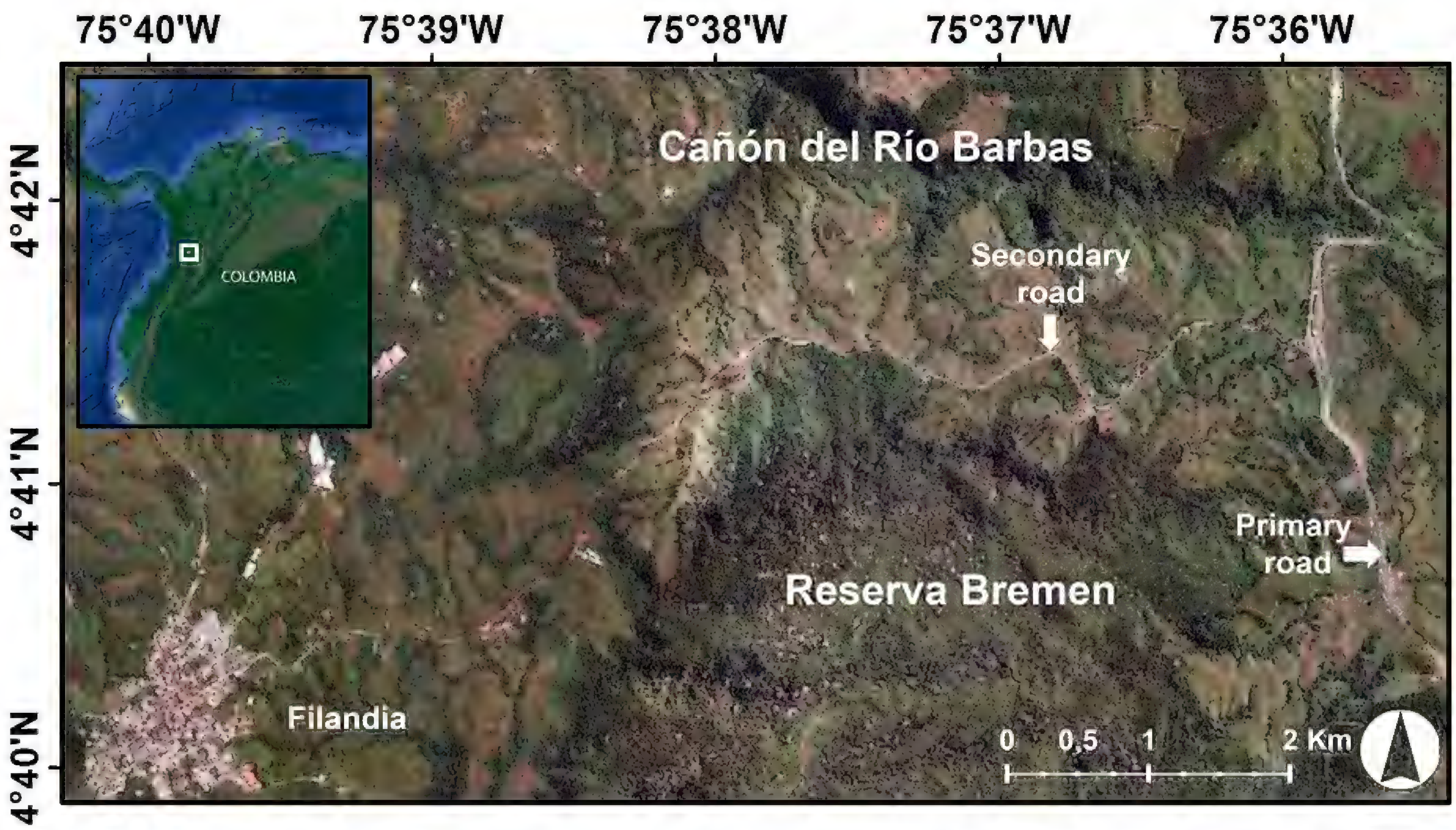

Fig. 1. Geographic location of the study area. Primary road (*Autopista del Café*) and the secondary road connecting *Autopista del Café* with the town of Filandia in the department of Quindío, Central Andes of Colombia. Adapted from SIG Quindío 2016. http://190.85.164.56/sigquindioiii/

quantification of roadkill rates is crucial for assessing the negative impact of roadkills in animal populations, and for optimizing the allocation of the limited economic resources for management and conservation (Slater 2002; Fahrig and Rytwinski 2009).

Snakes are one of the most commonly killed vertebrates on roads, which has been attributed to several non-exclusive factors (Andrews et al. 2008). For instance, snakes may actively seek out roads for thermoregulation (Rosen and Lowe 1994; Ashley and Robinson 1996) and they are especially vulnerable to being killed because they tend to freeze when facing an anthropogenic stimulus such as the artificial light of approaching vehicles (Andrews and Gibbons 2005). In addition, many snakes are killed intentionally by drivers because of erroneous preconceptions of their venomous nature (Secco et al. 2014). Given that many species of snakes exhibit a small body size, their carcasses are expected to disappear from the road in less than one or two days, a shorter period than some protocols for monitoring roadkill (Antworth et al. 2005; Langen et al. 2007; DeGregorio et al. 2011; Santos et al. 2011). Therefore, the number of road-killed snakes can be highly underestimated if carcass persistence is not factored into roadkill rate calculations.

The only national estimate of snake roadkill for Colombia was published by Lynch (2012), based on records obtained on a road in Brazil (Monteiro et al. 2011) and a road in the western Andes of Colombia (Vargas-Salinas et al. 2011). That author mentions that mortality in Colombia due to collisions with vehicles could range from 52,600 to 176,660 snakes/yr in the primary road network of the country (10,300 km). However, that estimate is inaccurate because roadkill rates of snakes vary according to the characteristics of the roads, as well as features associated with the ecosystem bisected by the roads (Forman et al. 2003; van der Ree et al. 2015). Furthermore, estimates of roadkill rates provided by Lynch (2012) for Colombia are based on a conservative approximation of carcass persistence on roads (e.g., 3.5 days; Vargas-Salinas et al. 2011).

In this study, an initial estimate was made of the time that a snake carcass can persist on two roads in Colombia. Then, the relationships between the carcass persistence time and both snake body size and traffic frequency were examined. Finally, the roadkill rate of snakes on a secondary road in the Central Andes of Colombia studied by Quintero-Ángel et al. (2012) was recalculated by taking into account the results obtained here about carcass persistence. This recalculation was made to illustrate the importance of correcting roadkill rates for carcass persistence, and also to improve knowledge of road ecology, specifically, wildlife roadkills in Colombia. With these analyses, we seek to draw attention to the ecological impacts of roads on this country's snake fauna.

Materials and Methods

Study Area and Methodology

This study was conducted in a 4.5-km stretch along two roads located in the department of Quindío, in the Central Andes of Colombia (Fig. 1). One is a secondary road that connects the *Autopista del Café* (a major highway system) with the town of Filandia, which has an average width of 8 m and a traffic frequency of <1,000 vehicles/day. The other is a primary road (*Autopista del*

Fig. 2. Images of some species of snakes present in the study area and used in the field experiments. **(A)** *Mastigodryas boddaerti,* **(B)** *Tantilla melanocephala,* **(C)** *Dipsas sanctijoannis,* **(D)** *Erythrolamprus epinephelus,* **(E)** *Leptodeira annulata,* **(F)** *Oxyrophus petolarius. Photos by Lina M. Robayo-Palacio* (A), *Fernando Vargas-Salinas* (B–D), *Ana María Ospina-L* (E), *and Wolfgang Buitrago-González* (F).

Café) with a traffic frequency of >2,500 vehicles/day. This road is bordered by two margins, each with a width of 8 m. Because the two margins were separated by a median strip, and the field experiments were performed in just one of the margins (see below), the carcasses were assumed to be subjected to the impact of half of the traffic level (i.e., ~1,250 vehicles/day). The minimum distance between the two 4.5-km road segments was 1.5 km; and since the road stretches are close to each other, climatic conditions were assumed to be similar between them.

The temperature in the study area varies between 12 and 18 °C, with 83% mean annual relative humidity, and a mean precipitation of 2,515 mm/yr. The rainfall regime in this area is bimodal, with high precipitation levels during April–May and October–November (CRQ 2010); however, during the sampling period (August 2015–March 2016) summer environmental conditions predominated due to the "El Niño" phenomenon (NOAA http://www.noaa.gov/understanding-el-nino). The landscape surrounding both roads consisted of paddocks, croplands, and some remnants of bamboo (*Guadua angustifolia*) and secondary forest (Serna 2012).

Between August 2015 and March 2016, 81 carcasses of snakes were placed randomly in the two roads under study. Nine snake carcasses were placed on each road spaced 500 m apart. The carcasses were placed on the roads between 0630 and 0700 h, and were monitored continuously throughout the day until 1800 h. The monitoring consisted of direct observations with binoculars at a distance of 50 m to avoid interfering with potential scavenger activity. The time of carcasses persistence and the causes of their eventual disappearance were recorded. A carcass was considered to be no longer detected when it was absent from the asphalt and the ground next to the road, or when the body was fragmented and degraded to a level that became unrecognizable from a potential

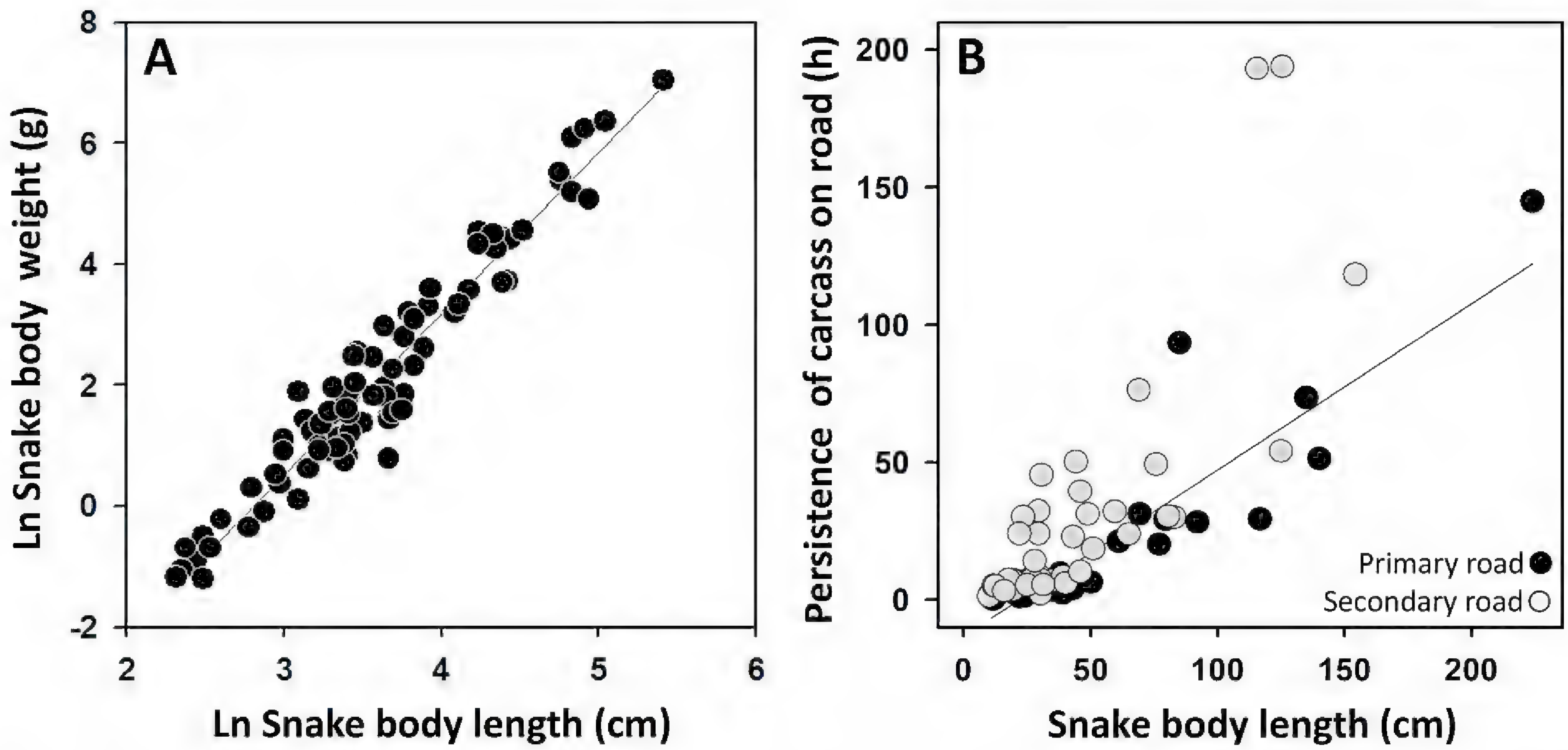

Fig. 3. (A) Relationship between weight and body length (Ln = natural logarithm) of snake carcasses used in this study. **(B)** Relationship between body length of snake carcasses and their persistence time on two roads with different levels of vehicular traffic.

observer located at the margin of the road. When carcasses disappeared during night (due to scavengers or any other factors), they were assumed to be removed the following morning when the monitoring restarted; in this way we were conservative in our estimates. Snake carcasses used in the present study were obtained from deaths and roadkills collected between April 2015 and March 2016 (Fig. 2; Appendix 1) in various places in the department of Quindío, Colombia. This study only used snakes recently run over with a non-flattened body and with fresh tissues and blood.

Although the carcasses used were taken from different locations in the department of Quindío, the species were locally distributed in the area of monitoring. The carcasses were frozen until the beginning of the field experiment. Individual taxonomic identification of the road-killed snakes was conducted based on prior knowledge of the species (Quintero-Ángel et al. 2012; Vanegas-Guerrero et al. 2016) and taxonomic descriptions in the literature (e.g., Lynch and Passos 2010; Peters and Orejas-Miranda 1970).

Data Analysis

A *t*-test was used to verify that there were no differences in the total length (hereafter, body size) or mass of the carcasses used in the field experiments between the primary and the secondary roads. A high correlation between the body size and weight of the snake carcasses was corroborated using a linear regression analysis; therefore, only the body size of the individual was used for subsequent analysis.

To achieve the first aim of this study, the median value of carcass time persistence for each type of road was estimated. In addition, a Kaplan-Meier estimator (Therneau and Grambsch 2000) was performed to calculate the probability of a carcass remaining on the road surface (i.e., potentially detectable by a researcher) through time. These probabilities were obtained for the primary and secondary roads separately. For the second objective, an analysis of covariance (ANCOVA) was applied; where the snake body size and type of roadway (primary, secondary) were the explanatory variables, while the carcass persistence time was the response variable. To achieve the third objective, the median persistence time of snake carcasses obtained for the secondary road in the study was used to recalculate the roadkill rate published by Quintero-Ángel et al. (2012). This estimation was reasonable because that study was made in the same secondary road stretch as the current experiments. The new roadkill rate estimate (RRE) was made using the following equation:

$$\mathrm{RRE}=\left[\frac{\text{Number of carcass}}{\text{Length of surveyed road stretch (Km)}}\right]\left[\frac{\text{Days of year (365)}}{\text{Monitoring time period (days)}}\right]\left[\frac{\text{Time between samplings (days)}}{\text{Median persistence time (in days) of carcass}}\right]$$

Results

There were no differences in the body size and weight of the carcasses between the primary and secondary roads (body size: t = 0.283, df = 79, P = 0.77; body weight: t = 0.451, df = 79, P = 0.653), and there was a strong positive relationship between the body size and weight of the snake carcasses (R^2 = 0.73, F = 225.135, β = 0.86, P < 0.001; Fig. 3A).

In this study, 81 carcasses were used which belonged to 14 species distributed in three families: Colubridae (41 individuals), Dipsadidae (39), and Elapidae (1).

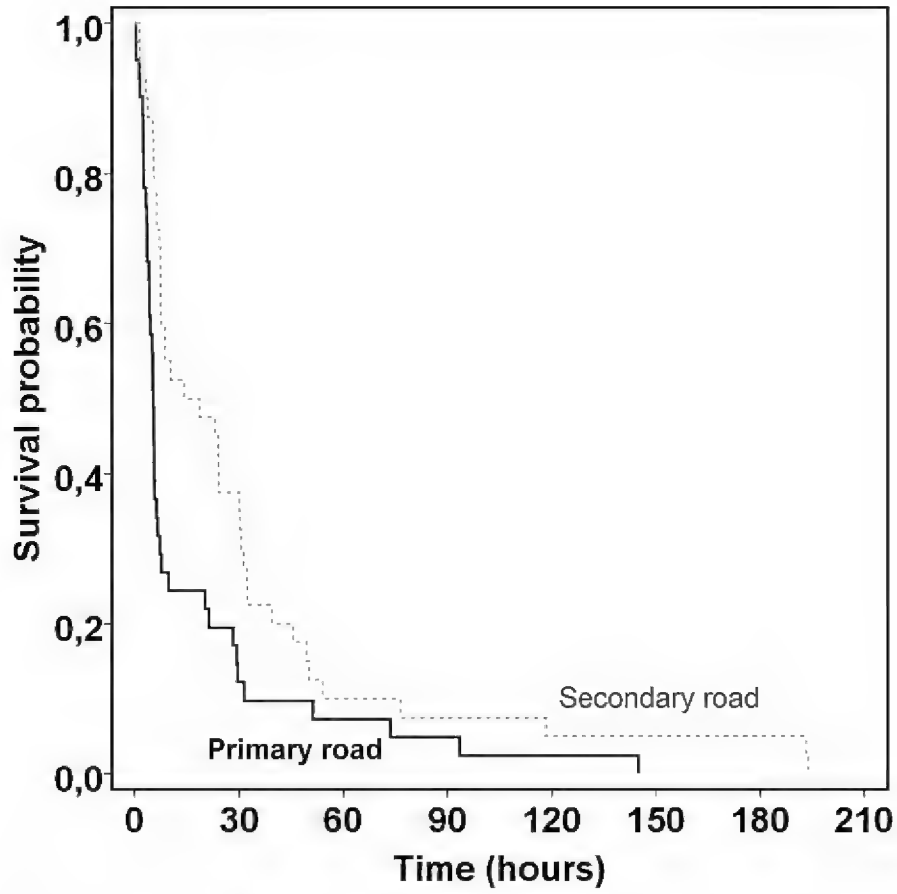

Fig. 4. Survival curves (i.e., probability of persistence on the road) for snake carcasses on primary and secondary roads in the municipality of Filandia, department of Quindío, Central Andes of Colombia. Kaplan-Meier estimates based on a sample size N = 81 snake carcasses.

The median persistence time of the snake carcasses on the primary road was 5.20 h (range = 0.26–145.0 h; N = 41 individuals), while on the secondary road it was 14.16 h (range = 0.27–193.90 h; N = 40 individuals). By combining the data from both types of roadway, the median persistence time of the carcasses was 7.16 h (range = 0.26–193.90 h). The persistence probability dropped substantially beyond 24–48 h for both the primary and secondary roads; in other words, after a snake has been killed, the probability that a researcher would be able to record the carcass on the road is less than 0.25 after, for example, 30 h (Fig. 4). During the daytime, the main cause of carcass disappearance was degradation due to vehicular traffic (65 of the 81 carcasses), and only three carcasses were removed by scavengers (birds). Thirteen other carcasses disappeared at night so it was not possible to determine the cause (see Appendix 1).

Compared to carcasses with a smaller body size, snakes with a larger body size tended to persist longer on the roads (ANCOVA F = 169.68, df = 1, P < 0.001). Although the type of road did not influence the carcass persistence time (F = 0.124, df = 1, P = 0.725), the analysis of covariance revealed that carcass size/type of road interaction had a significant effect on carcass persistence (F = 11.35, df = 1, P = 0.001). If the carcass was small, it tended to persist for the same time on the primary road as on the secondary road; however, when the carcass was large, the difference in persistence time between road types increased, being lower on the primary road compared to the secondary road (Fig. 3B). Using these results of median carcass persistence time on the secondary road, the roadkill rates of snakes for the location reported by Quintero-Ángel et al. (2012), increased substantially, from 78.8 individuals/km/year to 934.83 individuals/km/year.

Discussion

The estimate of snake carcass persistence time on roads followed a general trend found in similar studies. In North America, South America, and Europe, nearly 50% of carcass disappearance from the roadway occurs during the first 8 to 24 h (DeGregorio et al. 2011; Santos et al. 2011).

Snake carcasses with a larger body size were found to persist longer than carcasses with a smaller body size on the roads. This result is in agreement with Santos et al. (2011), but disagree with the findings of Antworth et al. (2005), DeGregorio et al. (2011), and Hubbard and Chalfoun (2012). The results here differ from those observed by Antworth et al. (2005) possibly because a relatively small range of snake carcass sizes (54.3–136 cm) was used in that study compared with the current study (range: 10.1–224 cm; see Appendix 1). Regarding the results obtained by DeGregorio et al. (2011), these authors placed the carcasses on the roadsides to evaluate only the effect of scavengers on carcass persistence, excluding the effect of traffic. In this study, carcass persistence was mainly determined by the action of vehicular traffic and not by scavengers. Finally, it is possible that Hubbard and Chalfoun (2012) did not find a relationship between carcass body size and persistence time because they used portions of fishes for their field experiments, which do not resemble the consistency of snake carcasses that are covered with scales and include a bone structure (i.e., spinal column). Characteristics such as scales, the presence or absence of hair, and spines on animal bodies have been found to allow corpses to better withstand the passage of vehicles and last longer on roadways (Santos et al. 2011).

The lack of statistical differences in the persistence time of carcasses between the primary and secondary roads might be attributed to the relatively small difference in traffic that could potentially hit the carcasses (~1,250 vehicles/day vs. <1,000 vehicles/day, respectively). Nevertheless, Santos et al. (2011) also found no significant differences on snake carcass persistence among four types of roadways (<1,000; 1,000–4,000; 4,000–10,000; and >10,000 vehicles/day). However, this result could be a sampling artifact, given the relatively small sizes of the snakes used in that study (15–240 g), which may not have allowed the recording of an interaction between the level of traffic and the animal's body size. The present study used snake carcasses varying between 0.3 and 1,147.29 g (see Appendix 1) and found that differences in the persistence of carcasses among roads with a different frequency of traffic emerged with particularly large animals. A similar situation may have occurred in Ratton et al. (2014), where a slight variability in weight (mean = 39.6 ± (SD) 2.1 g) of poultry corpses

(*Gallus domesticus*) may have accounted for the absence of significant differences in the persistence of carcasses between a highway and an unpaved roadway with sparse vehicular traffic.

The recalculation of the snake roadkill rate obtained by Quintero-Ángel et al. (2012) on a secondary road of Central Andes of Colombia, pointed out that including the data of carcass persistence time may increase estimates of snake roadkill significantly; specifically, an 11.86-fold increase. However, the same level of increase should not necessarily be found in other localities or with other organisms. In this regard, recent studies testing previous estimates of roadkills in countries such as Brazil, Spain, United States of America, and Wales, showed a high underestimation in roadkill values (Slater 2002; Loss et al. 2014; Ruiz-Capillas et al. 2015; Santos et al. 2011; Santos et al. 2016).

Because roadkill rate and carcass persistence time can vary significantly between areas with different landscape configurations, weather regimes, and roads, it was not possible to estimate snake roadkill at the country level. The simple extrapolation of the results from the current study area (which is small in proportion to the size of the road network in Colombia) is not adequate. This is especially true for a country like Colombia, which exhibits an intricate topography that is reflected in a high diversity of ecosystems and a concomitant spatial variation of snake diversity (Lynch 2012). Additional studies examining snakes road-killed in different regions and ecosystems of Colombia could help to provide a better estimate of snake mortality for the country (e.g., Payan et al. 2013; Castillo-R et al. 2015; De La Ossa-V and Galván-Guevara 2015; Rincón-Aranguri et al. 2019); however, in those studies carcass persistence was not evaluated.

Finally, according to the results obtained here, in order to accurately estimate the roadkill rate for snakes, and many other small vertebrates, a daily monitoring schedule should be adequate (see Santos et al. 2011). This monitoring frequency is higher than those reported in previous studies from Colombia and other countries. Nevertheless, it is important to remember that this sampling capacity would depend to a large degree on the economic support available.

Conclusion and Perspectives

This study highlights that the problem of road-killed snakes on the road infrastructure of Colombia is greater than previously believed. More data on carcass persistence time obtained from different localities and different types of roads (e.g., paved, non-paved) around the country are necessary for determining an accurate estimate of the number of snakes killed annually in Colombia. Given that collisions may be related to a species population size (Rosen and Lowe 1994; Row et al. 2007; Fahrig and Rytwinski 2009), these results bear important implications for visualizing the need for conservation plans against roadkills. Snakes are important prey and predators in terrestrial ecosystems (Diller and Johnson 1988; Godley 1982), and for this reason, the impact of roadways on snake populations might even be reflected at the ecosystem level (Forman and Alexander 1998).

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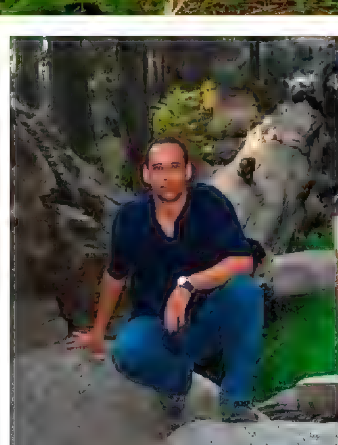

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Appendix 1. Taxonomic identity and associated information of snake carcasses used in the field experiments.

Taxon	Collection date	Place of origin	Body length (cm)	Weight (g)	Cause of disappearance	Period of disappearance
COLUBRIDAE						
Chironius monticola	7/10/2015	Filandia	125	179.5	traffic	day
Chironius monticola	27/05/2015	Buenavista	48.9	13.8	traffic	day
Dendrophidion bivittatus	27/11/2015	Filandia	29.5	2.8	traffic	day
Lampropeltis triangulum	4/10/2015	Filandia	69.3	93.33	traffic	day
Lampropeltis triangulum	13/10/2015	Filandia	69	76	traffic	day
Mastigodryas boddaerti	13/04/2015	Calarcá	79.4	86.43	traffic	day
Mastigodryas boddaerti	24/03/2016	Quimbaya	140	160.8	traffic	day
Spilotes pullatus	4/11/2015	Quimbaya	224	1,147.29	traffic	day
Tantilla melanocephala	12/08/2015	Filandia	26	2.6	traffic	day
Tantilla melanocephala	26/06/2015	Filandia	29.4	5.16	traffic	day
Tantilla melanocephala	10/05/2015	Filandia	43.1	6.4	traffic	day
Tantilla melanocephala	20/08/2015	Filandia	39	2.2	traffic	day
Tantilla melanocephala	15/05/2015	Filandia	27	4.5	traffic	day
Tantilla melanocephala	25/08/2015	Autopista del Café	12	0.61	traffic	day
Tantilla melanocephala	20/08/2015	Autopista del Café	11.5	0.41	traffic	day
Tantilla melanocephala	1/09/2015	Autopista del Café	38.2	6.17	traffic	day
Tantilla melanocephala	19/09/2015	Filandia	27	2.5	traffic	day
Tantilla melanocephala	10/09/2015	Filandia	35.5	6.22	traffic	day
Tantilla melanocephala	10/09/2015	Filandia	33	3.96	traffic	day
Tantilla melanocephala	10/09/2015	Filandia	24	3.5	traffic	day
Tantilla melanocephala	13/02/2016	Filandia	42.4	4.9	traffic	day
Tantilla melanocephala	15/02/2016	Filandia	25	2.5	traffic	day
Tantilla melanocephala	15/02/2016	Filandia	12.5	0.5	traffic	day
Tantilla melanocephala	7/02/2016	Circasia	16	0.7	traffic	day
Tantilla melanocephala	7/11/2015	Autopista del Café	25.1	2.7	traffic	day
Tantilla melanocephala	7/11/2015	Autopista del Café	28.5	3.1	unknown	night
Tantilla melanocephala	7/11/2015	Autopista del Café	10.7	0.5	traffic	day
Tantilla melanocephala	7/11/2015	Autopista del Café	20	2.5	traffic	day
Tantilla melanocephala	10/07/2015	Filandia	39.2	4.19	traffic	day
Tantilla melanocephala	10/07/2015	Autopista del Café	10.5	0.35	traffic	day
Tantilla melanocephala	5/09/2015	Filandia	30.33	6.6	traffic	day
Tantilla melanocephala	5/09/2015	Filandia	25.4	3.87	traffic	day
Tantilla melanocephala	2/09/2015	Autopista del Café	10.1	0.31	traffic	day
Tantilla melanocephala	2/09/2015	Filandia	40.2	4.7	traffic	day
Tantilla melanocephala	29/10/2015	Filandia	30.34	4.61	traffic	day
Tantilla melanocephala	19/10/2015	Filandia	19	1.7	traffic	day
Tantilla melanocephala	6/11/2015	Filandia	12	0.3	traffic	day
Tantilla melanocephala	19/10/2015	Filandia	17.7	0.92	traffic	day
Tantilla melanocephala	19/10/2015	Filandia	23.4	1.85	traffic	day
Tantilla melanocephala	27/02/2016	Filandia	28	2.6	unknown	night
Tantilla melanocephala	17/02/2016	Filandia	13.5	0.8	traffic	day

Appendix 1 (continued). Taxonomic identity and associated information of snake carcasses used in the field experiments.

Taxon	Collection date	Place of origin	Body length (cm)	Weight (g)	Cause of disappearance	Period of disappearance
DIPSADIDAE						
Atractus cf. *melanogaster*	20/08/2015	Filandia	23	4.18	traffic	day
Atractus cf. *melanogaster*	20/08/2015	Filandia	38.8	4.24	traffic	day
Atractus cf. *melanogaster*	5/09/2015	Autopista del Café	30.6	3.4	traffic	day
Atractus cf. *melanogaster*	15/11/2015	Filandia	30	5	traffic	day
Atractus sp.	19/08/2015	Filandia	20	3.02	traffic	day
Atractus sp.	20/01/2015	Filandia	30	2.32	traffic	day
Atractus sp.	5/09/2015	Filandia	19.5	1.45	unknown	night
Atractus sp.	30/02/2016	Filandia	27.5	7.2	traffic	day
Atractus sp.	4/12/2015	Filandia	22	6.7	traffic	day
Atractus sp.	7/03/2016	Filandia	31.4	7.8	traffic	day
Atractus sp.	4/09/2015	Filandia	32	12.78	traffic	day
Atractus sp.	30/08/2015	Filandia	43.1	16.42	unknown	night
Clelia sp.	23/11/2015	Filandia	75.8	90.2	traffic	day
Clelia sp.	8/11/2015	Filandia	115.5	249.7	traffic	day
Clelia sp.	4/12/2015	Filandia	125.5	443.1	traffic	day
Clelia sp.	17/03/2016	Quimbaya	154.3	581.2	unknown	night
Clelia sp.	17/02/2016	Filandia	135	520.06	traffic	day
Dipsas cf. *sanctijoannis*	20/09/2015	Filandia	85	83.1	unknown	night
Dipsas cf. *sanctijoannis*	28/09/2015	Filandia	77	70.3	unknown	night
Dipsas cf. *sanctijoannis*	22/07/2015	Filandia	83	41.69	traffic	day
Dipsas cf. *sanctijoannis*	19/10/2015	Filandia	80.5	40.71	scavenger	day
Dipsas cf. *sanctijoannis*	11/10/2015	Filandia	65.1	35.94	traffic	day
Dipsas cf. *sanctijoannis*	6/11/2015	Filandia	46	10.2	unknown	night
Dipsas cf. *sanctijoannis*	12/02/2016	Circasia	61	28.4	unknown	night
Dipsas cf. *sanctijoannis*	5/03/2016	Filandia	92	95.5	traffic	day
Dipsas cf. *sanctijoannis*	10/09/2015	Filandia	116.6	222.33	traffic	day
Erythrolamprus epinephelus	7/06/2015	Filandia	38	19.65	traffic	day
Erythrolamprus epinephelus	21/05/2015	Filandia	38	7.1	unknown	night
Erythrolamprus epinephelus	20/08/2015	Filandia	50.2	27.46	traffic	day
Erythrolamprus epinephelus	25/09/2015	Filandia	16.3	1.36	traffic	day
Erythrolamprus epinephelus	10/07/2015	Filandia	35.4	11.73	unknown	night
Erythrolamprus epinephelus	2/09/2015	Filandia	44.2	24.66	traffic	day
Erythrolamprus epinephelus	29/10/2015	Filandia	26.8	4.82	scavenger	day
Erythrolamprus epinephelus	7/11/2015	Filandia	51	36.6	traffic	day
Erythrolamprus epinephelus	30/11/2015	Filandia	46	22.1	unknown	night

Appendix 1 (continued). Taxonomic identity and associated information of snake carcasses used in the field experiments.

Taxon	Collection date	Place of origin	Body length (cm)	Weight (g)	Cause of disappearance	Period of disappearance
Erythrolamprus epinephelus	27/12/2015	Filandia	40	9.7	traffic	day
Oxyrhopus petolarius	12/11/2015	Caicedonia	29.5	2.09	traffic	day
Oxyrophus petolarius	29/10/2015	Filandia	59.5	24.44	scavenger	day
Leptodeira annulata	7/03/2016	Armenia	31.2	12.1	unknown	night
ELAPIDAE						
Micrurus mipartitus	4/04/2015	Quimbaya-Filandia road	22	1.12	traffic	day